however, is probably variable even within the same species; nor can it be a sexual character, as out of two male specimens of *Mergana equilinearia* in the collection, one has two, the other four tibial spurs.

I submitted all the synonyms enumerated above to the consideration of Mr. Butler, who kindly endorsed their correctness.

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## MISCELLANEOUS.

### *The System of the* Monactinellidæ. By Dr. R. von Lendenfeld.

The rich collections of Australian sponges in the museums at Adelaide, Christchurch, and Dunedin, which were placed at my disposal by Dr. Haacke, Dr. J. von Haast, and Prof. Parker, as well as the material collected by myself among the Australian shore-sponges, include about 500 species, of which I have only been able to identify a few with forms already described. I have easily recognized among my specimens a number of the species accurately described by Selenka and Marshall, but have had little success in the identification of the species from the Australian region described by English and American authors.

As was very justly foreseen by O. Schmidt, it is not practicable to regard the system of the sponges established upon the Mediterranean fauna, and enlarged through the Atlantic forms, as universally applicable; uniting intermediate forms make their appearance where, from known facts, one would have suspected no relationship. However, the new forms furnish further proofs of the correctness of Zittel's system, and I have taken this as the foundation of my investigations.

The Calcispongiæ are few and insignificant. Hexactinellidæ and, singularly enough, Tetractinellidæ also are almost entirely deficient. Of the latter group I have obtained two specifically different individuals. As Myxospongiæ are also extremely rare (three species), the whole mass of the Sponges is distributed in the two groups of the Monactinellidæ and Ceraospongiæ.

I have carefully examined the Monactinellidæ especially, and will, in what follows, bring together the most important systematic results of this work.

Although I worked upon sponges at home for a long time under F. E. Schulze's guidance, and have also paid much attention to them in Australia, the investigation of so great a number of forms as has lately been at my disposal has compelled me to arrive at a clear idea of what is to be understood as a species among sponges. In the siliceous sponges it is here, as elsewhere, merely the form of the spicules, and never their arrangement, that behaves conserva-

tively, and consequently can be applied to the establishment of the higher systematic groups. O. Schmidt's principle of division therefore applies also to the Australian sponge-fauna, divergent as it may be.

O. Schmidt has so far accepted a polyphyletic pedigree for the Chalinidæ as to derive the sponges with axial siliceous spicules in a network of horny fibres in part from the horny sponges and in part from the Renieridæ. I am in a position to describe a continuous series of forms which lead from the Ceraospongiæ to the true Renieridæ without any horny matter. There are all steps between the skeleton of the Chalcænidæ, consisting of spicules arranged in bundles and combined into thick cords, and the tissue of the typical Renieridæ, with its loose triangular meshes. Thus I possess a whole series of sponges the skeleton of which consists of parallel cords, representing the main fibres of the horny sponge. These cords consist of a dense mass of siliceous spicules, and are united with each other by *single* spicules of the same form, representing the uniting fibres. They are consequently separated from each other by the length of a spicule. In some of these sponges the main fibres are feeble and often bent, so that the looser Renierid tissue is formed by the weakening first of the uniting fibres and then of the main fibres of the Chalcænidæ. The Australian Renieridæ, however, show no relationship with the Myxospongiæ, from which they must have been derived, if not from the Chalinidæ.

Our sponges show that the non-ceratose Monactinellidæ represent the terminal members of a series which starts from the Ceraospongiæ. The spicules of the Monactinellidæ are either uni- or biradiates. (In this the biacuates $ac^2$ and *ac ac*, Vosmaer, are regarded as biradiates, and the obtuse-ended, tubercular, and pin-like forms *tr ac*, $tr^0$ *ac*, *tr ac sp*, Vosmaer, as uniradiates.) In agreement with F. E. Schulze, I regard the pluriradiate form as phylogenetically older.

I regard the spicules formed in the parenchyma of the sponge, the flesh-spicules, as in every respect essentially different from those which were deposited in the axes of the horny fibres, originally as biradiates, in the ancestors of the Chalinidæ. By reduction of the number of rays the obtuse-ended spicules have thus been developed from the biradiates, and from these again the pin-like and tubercular forms. In many cases a gradual disappearance of the horny substance takes place *pari passu* with the transformation of the spicules, while in other cases again the spongioline disappears without the spicules changing their form.

If we now consider the Monactinellidæ from this point (for the present without reference to the flesh-spicules), we obtain the following classification, in which they form as a whole an order "Monactinellidæ" in the class of Sponges :—

*Suberitidæ.*

Uniradiates without perceptible horny substance.

*Chlathridæ.*

Network of horny fibres with imbedded obtuse spicules.

*Renieridæ.*

Biradiates without perceptible horny substance.

*Echispidæ.*

Network of horny fibres with imbedded uni- or biradiates and projecting tubercular spicules.

*Chalcœnidæ.*

Network of horny fibres with dense masses of coarse imbedded biradiates.

*Chalarchidæ.*

Network of horny fibres with scanty, axial, extremely delicate biradiates.

Ceraospongiæ.

The Chalarchidæ and Chalcœnidæ, at least the Australian forms, are so different from each other, that for the sake of uniformity I have preferred to divide the Chalinidæ of authors into these two main sections. O. Schmidt's numerous families of Chalinidæ would in this scheme appear as subfamilies.

Among the Chalarchidæ we find sponges resembling *Euspongia*, *Cacospongia*, and *Spongelia*. Possibly therefore the pedigree of the Chalarchidæ may be polyphyletic, different members of the family being descended from the above-mentioned horny sponges.

I will here mention a peculiar intermediate form which combines characters of the Chalarchidæ with those of *Spongelia*. The skeleton of this sponge consists of a ladder-like network of horny fibres. The radial main fibres are entirely filled with sand, and bear no spicules. The tangential uniting fibres, which are not much weaker and do not anastomose with each other, are entirely filled with axial, evidently self-formed biradiates, and bear no foreign bodies.

The Echispidæ for the most part coincide with Gray's Echinonemata.

I have found an interesting form which so far unites this family with the Chlathridæ, that we find in this sponge projecting, obtuse, perfectly smooth spicules in great quantity, but no tubercular spicules.

Among the other three families which include O. Schmidt's groups of the same names, we should then have the Desmacidonidæ* to distribute.

I have proposed the foregoing classification without reference to the flesh-spicules, the multifarious anchors, hooks, &c. of the Desmacidonidæ, and without taking into account the siliceous stars in the cortex of many Monactinellidæ.

I regard it as preferable not to adduce the flesh-spicules in the formation of the principal groups, but rather to employ them as generic characters. Although I have long been inclined to this view, I have hitherto refrained from bringing it forward, as authorities like Vosmaer and O. Schmidt lay great stress upon the separation especially of the anchor- and hook-bearing sponges and their collocation to form a whole. In the same way, however, that O. Schmidt united sponges with and without siliceous stars in the family Gummineæ, I think we may bring together Monactinellid families with and without anchors &c., provided they agree in the structure of the fibrous skeleton.

I believe that these flesh-spicules are of cœnogenetic origin. O. Schmidt has demonstrated that in part they contain much more organic material than those siliceous structures which occur in the corals. Their cœnogenetic character is especially proved by the extraordinary multiplicity and variability of their forms. In sponges which show themselves to be nearly allied by the character of their fibrous skeleton we often find anchors in one and nothing siliceous in the parenchyma of another; while, on the other hand, hooks occur in very different sponges. We usually meet with them in sponges the fibres of which contain Monactinellid spicules. But I possess a well-preserved spirit-specimen of a sponge from Port Phillip, which is a true *Hircinia,* and the fibres of which contain no siliceous spicules, while in its parenchyma, besides the filaments, great quantities of S-shaped double hooks are to be found.

The same applies to siliceous stars. These may sometimes occur and sometimes be deficient in nearly allied forms, while, on the other hand, they are found in very different sponges.

If we represent the system of the sponges in the form of a genealogical tree, taking the above conceptions as the foundation, we arrive at the following conclusions :—

1. From the Myxospongiæ originates a series of forms, the central members of which resemble the Spongidæ. From the sides of this series branches are given off, at the extremities of which stand the Aplysinæ and Hirciniæ. The Chalarchidæ and Chalcænidæ are placed in the upper part of the series, from the end of which the Renieridæ, Suberitidæ, and Echispidæ radiate like an umbel. The

* Of course I can here refer only to the most important groups.

Gummineæ have branched off between the Myxospongiæ and the Spongidæ.

2. In all the forms of this series, from *Halisarca* to *Suberites* or *Reniera*, we meet with the tendency to form flesh-spicules.

3. The flesh-spicules are quite independent of the rest of the skeleton, and occur in two types, Monactinellan (anchors &c.) and Polyactinellan (stars &c.).

4. When another skeleton was already formed by production of fibres, when the flesh-spicules originate they remain small and unimportant, and in this case it is of no consequence whether the fibrous skeleton consists of horny substance (*Hircinia*), connective cords (Gummineæ), or siliceous cords (Desmacidonidæ).

5. When there was no fibrous skeleton when the flesh-spicules were formed they attained considerable dimensions, and on their own part formed connected frameworks. Both the Monactinellan and the Polyactinellan forms occur in these sponges. The anchor-spicules of the Tetractinellidæ perhaps belong in part to the former, and the structures in Tetractinellidæ and Hexactinellidæ originating by reduction of the many rays to 4 or 6 to the latter group. The Plakinidæ unite all these with *Halisarca*.

From the series of fibrous sponges which culminates in the non-horny Monactinellidæ branches are given off at many points in the same direction, all parallel to that powerful but homologous branch which contains the Hexactinellidæ and Tetractinellidæ.—*Zoologischer Anzeiger*, No. 164, April 7, 1884, vii. p. 201.

*On* Orbulina universa. By M. C. Schlumberger.

Several naturalists have already paid attention to the genetic relations which appear to exist between the *Orbulinæ* and the *Globigerinæ*, which are so abundantly distributed in our seas. Pourtalès* was the first to indicate the presence of a *Globigerina* in the interior of *Orbulinæ* dredged in the Gulf-stream. Dr. A. Krohn† made the same observation upon living *Orbulinæ* taken at Madeira. These two observers‡ concluded that the *Orbulina* gives origin to a *Globigerina*, which, increasing in size, finally bursts the sphere which encloses it and escapes to lead an independent existence. Carpenter§, in his classical work on the Foraminifera, opposes this opinion by a series of irrefutable arguments and retains the two genera *Orbulina* and *Globigerina* founded by D'Orbigny.

Recent researches upon the embryogeny of the Foraminifera have

* Silliman's Journal, July 1858; reprinted in this Journal, ser. 3, vol. ii. p. 235.

† Referred to in a paper by Prof. Max Schultze, in the Arch. f. Naturg. 1860, p. 287; translated in this Journal, ser. 3, vol. vii. The point is discussed at pp. 311–313.

‡ Krohn simply observed the fact and communicated it to Max Schultze.

§ Introduction to the Study of Foraminifera, 1862.